

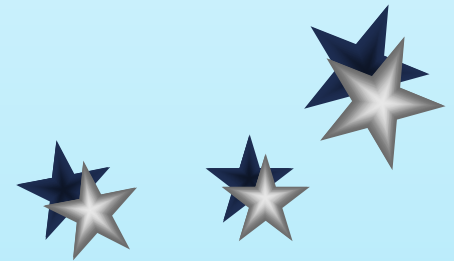


Federally-Funded Information Technology Research and Development

Cita M. Furlani

**Director, National Coordination Office for Information Technology
Research and Development**

January 9, 2002





Information Technology is one of the key factors driving progress in the 21st century

Information Technology is transforming the way we:

- Communicate
- Deal with information
- Learn
- Practice health care
- Conduct commerce
- Work
- Design and build things
- Conduct research
- Deal with the environment
- Conduct government

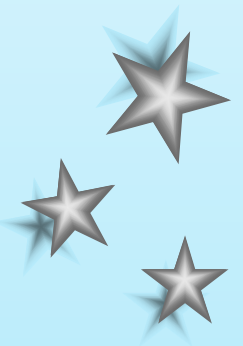
Information technology is creating a new foundation for business, scientific research, and social interaction





The Federal government plays a critical role in supporting fundamental IT R&D

- Federally-sponsored research has helped build the technology base on which the IT industry has grown
- Fundamental research is key to stimulating innovation, and innovation is key to continued U.S. leadership in IT
- The Federal government funds basic research not traditionally funded by the commercial sector
 - High risk, innovative ideas whose practical benefits may take years to demonstrate
- Federal funding for research plays a critical role in educating students in computing, communications, IT, and IT applications





Industry's Role in IT R&D

- The industrial R&D investment, though large in dollars, is different in nature:
 - Research is focused on short-term results – more than 90% of IT R&D expenditures are for product development, and product life cycles are typically 18 months or less
- Federal funding is often carried out in close cooperation with industry (for example, joint testbeds)
- The benefits of fundamental research are generally too far in the future and too uncertain to receive significant industry support. However, ...
- Federal IT research drives industry innovation by generating many technologies later commercialized into pervasive products (such as the mouse, high-speed networks, Web browsers, and search engines)
- “The fundamental investments in university research by the Federal government have served to train the majority of our information technology professionals.” — IT industry leaders on the President's Information Technology Advisory Committee





Information Technology – An Essential National Interest

Past Federal investments have yielded spectacular returns

- The Internet, the first graphical Web browser, advanced microprocessors
- IT accounts for one-third of U.S. economic growth and employs 10.4 million Americans
- Business-to-consumer e-commerce is projected to grow to \$156 billion by 2005
- From 1994 to 2001, the number of U.S. home Web users has increased from 3 million to more than 89 million
- More than a third of a billion people worldwide now use the Internet

***We have an essential national interest in ensuring a continued
flow of good new ideas and trained professionals in
information technology***

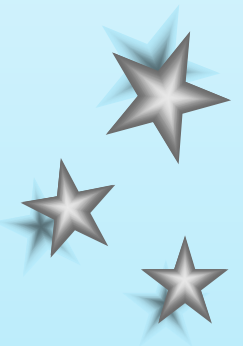





Aggressive IT R&D is essential for achieving 21st century aspirations

- Stronger national security
- Improved quality and delivery of health care
- Safer and cheaper transportation by air, land, and sea
- Improved climate models to support more informed decisions
- More efficient and responsive government
- Better quality and delivery of education and training to all Americans
- Decreased reliance on untested and insecure information systems
- Increased productivity of research in all disciplines
- A safer and improved environment through efficient design and operation of buildings, vehicles, and equipment
- Better warnings of dangerous weather
- Faster response to hazardous materials releases

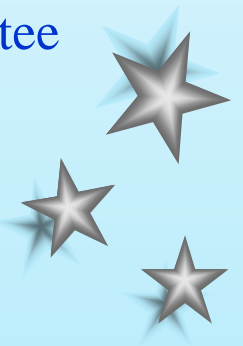
***Opportunities for innovation in IT are large –
and becoming even more important***





History of The Federal HPCC Initiative (HPC Act of 1991, P.L. 102-194)

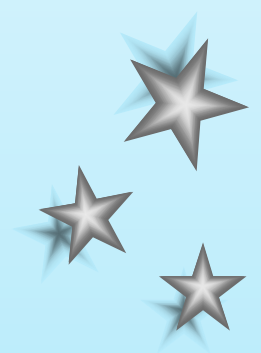
- Chartered by Congress FY 1992 through FY 1996 with the High Performance Computing Act of 1991
- Focused on:
 - High Performance Computing Systems
 - Advanced Software Technology and Algorithms
 - National Research and Educational Network
 - Information Infrastructure Technology and Applications
 - Basic Research and Human Resources
- Was coordinated through the High Performance Computing, Communications, and Information Technology (HPCCIT) Subcommittee and NCO





HPCC Program Goals

- Extend U.S. technological leadership in high performance computing and computer communications
- Provide wide dissemination and applications of these technologies to speed the pace of innovation and improve national economic competitiveness, national security, education, health care, and the global environment
- Provide key enabling technologies for the National Information Infrastructure (NII) and demonstrate select NII applications





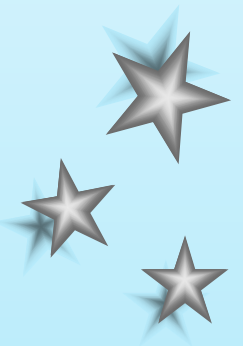
Federal HPCC Program Contributions

- Scalable parallel systems
- Enabling technologies for workstations, distributed systems
- Microkernel operating systems
- Internet networking technology
- Information infrastructure, including early WWW browsers
- Research for digital libraries
- Gigabit testbeds
- Supercomputer Centers
- Grand Challenge Applications
- National Challenge Applications
- Mission applications: e.g., national security, medicine, environment, and education





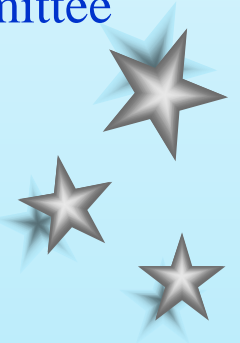
From HPCC to IT R&D





Information Technology R&D Program

- Evolved from the Federal HPCC and CIC programs
- Provides a mechanism for focused long-term interagency R&D in information technologies
- \$2 billion multi-agency Information Technology R&D Program
 - 12 agencies and departments coordinated via a “virtual agency” coordination/management structure
 - Coordinated by the National Coordination Office for Information Technology Research and Development
- Assessed by the President’s Information Technology Advisory Committee

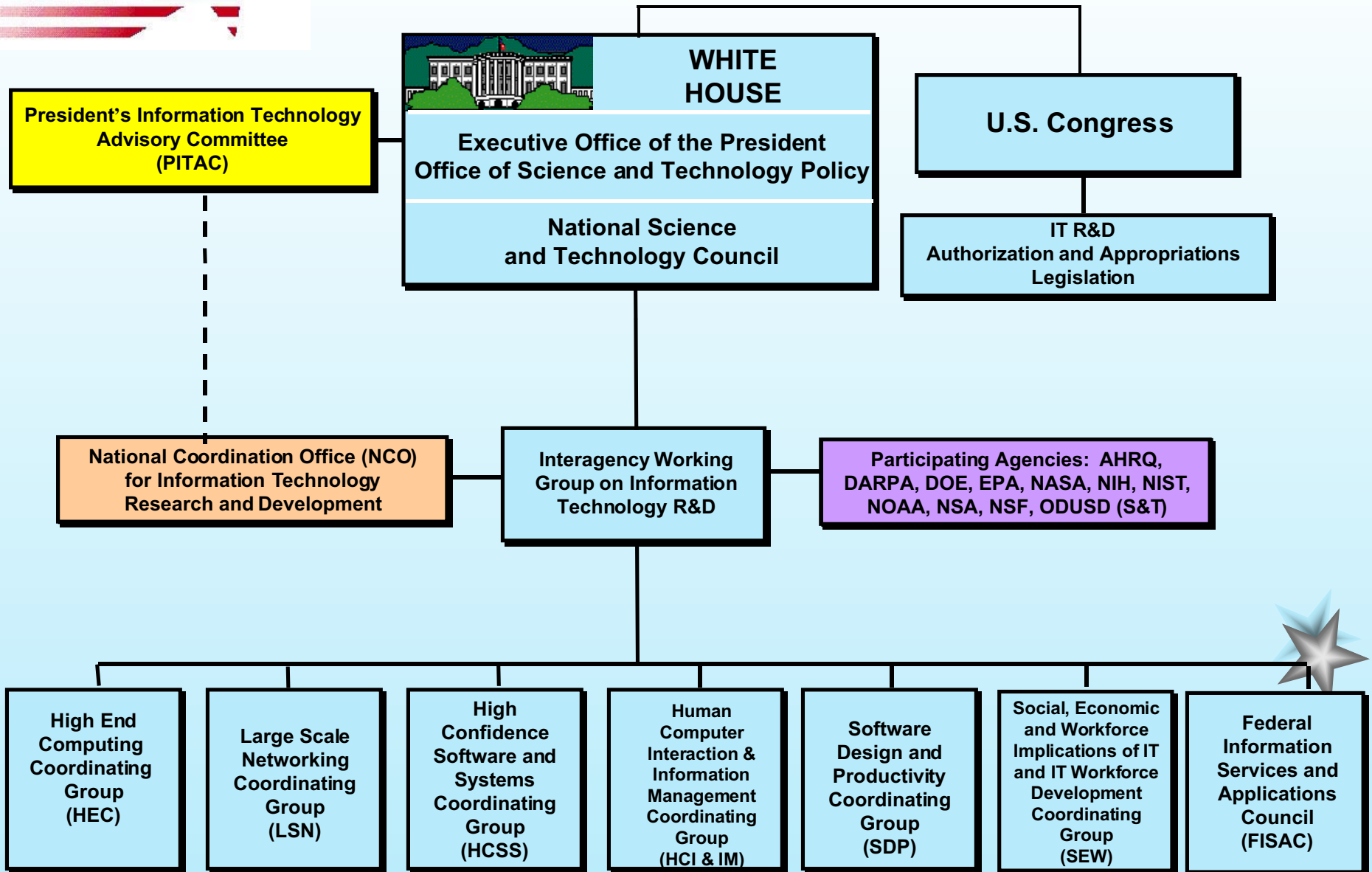


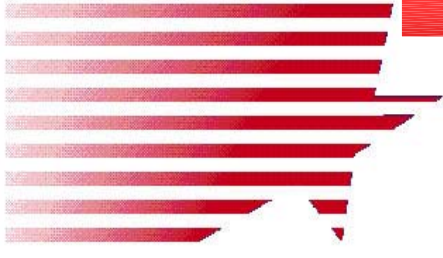


Participating Agencies and Departments

- National Science Foundation (NSF)
 - Defense Advanced Research Projects Agency (DARPA)
 - National Institutes of Health (NIH)
 - National Aeronautics and Space Administration (NASA)
 - Department of Energy Office of Science (DOE/OS)
 - National Security Agency (NSA)
 - National Institute of Standards and Technology (NIST)
 - National Oceanic and Atmospheric Administration (NOAA)
 - Agency for Health Research and Quality (AHRQ)
 - Office of the Deputy Under Secretary of Defense for Science and Technology (ODUSD (S&T))
 - Environmental Protection Agency (EPA)
 - Department of Energy National Nuclear Security Administration (DOE/NNSA)
- 

Coordination of IT R&D Programs

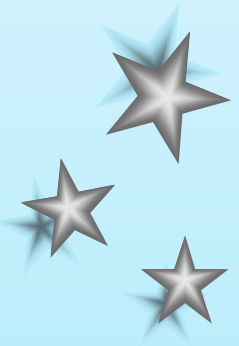




President's Information Technology Advisory Committee (PITAC)



- Top IT experts from academia and industry
- Advises the Administration on how to accelerate the development and adoption of information technologies
- *Information Technology Research: Investing in Our Future (1999)*
 - Recommended increasing strategic investments from \$1.46 billion in FY 2000 to \$2.83 billion in FY 2004
 - Four priority areas for long-term R&D:
 - Software
 - Scalable information infrastructure
 - High-end computing
 - Socioeconomic impact

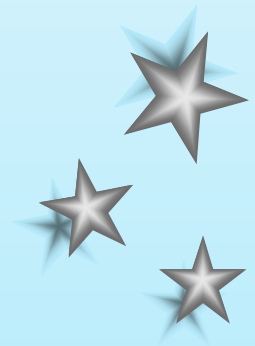




PITAC Reports



- **In 2000, three panel reports were released:**
 - *Resolving the Digital Divide: Information, Access and Opportunity*
 - *Transforming Access to Government through Information Technology*
 - *Developing Open Source Software to Advance High End Computing*
- **In 2001, three panel reports were released:**
 - *Transforming Health Care Through Information Technology*
 - *Using Information Technology To Transform the Way We Learn*
 - *Digital Libraries: Universal Access to Human Knowledge*
- **Current Agenda:**
 - National Security
 - Individual Security
 - Update 1999 Report





1997 - 2001 Membership Included:



Industry

- Eric A. Benhamou, Ph.D. / **3Com Corporation**
- Vinton Cerf, Ph.D. / **WorldCom**
- Steven D. Dorfman (retired) / **Hughes Electronics Corporation**
- David W. Dorman / **AT&T**
- Robert Ewald / **Learn 2 Corporation**
- James N. Gray, Ph.D. / **Microsoft Research**
- W. Daniel Hillis, Ph.D. / **Applied Minds, Inc.**
- William Joy / **Sun Microsystems**
- Robert E. Kahn, Ph.D. / **Corporation for National Research Initiatives (CNRI)**
- David C. Nagel, Ph.D. / **Palm, Inc.**
- Leslie Vadasz / **Intel Corporation**
- Andrew J. Viterbi, Ph.D. / **QUALC OMM Incorporated**
- Steven J. Wallach / **Chiaro Networks**
- Irving Wladawsky-Berger, Ph.D. / **IBM Corporation**

Academia

- Ching-chih Chen, Ph.D. / **Simmons College**
- David M. Cooper, Ph.D. / **Lawrence Livermore National Laboratory**
- Dave J. Farber / **University of Pennsylvania**
- Sherrilynne S. Fuller, Ph.D. / **University of Washington School of Medicine**
- Hector Garcia-Molina, Ph.D. / **Stanford University**
- Susan L. Graham, Ph.D. / **University of California - Berkeley**
- Ken Kennedy, Ph.D. / **Rice University**
- John P. Miller, Ph.D. / **Montana State University**
- Raj Reddy, Ph.D. / **Carnegie Mellon University**
- Edward H. Shortliffe, M.D., Ph.D. / **Columbia University**
- Larry Smarr, Ph.D. / **University of California - San Diego**
- Joe F. Thompson, Ph.D. / **Mississippi State University**





IT R&D Coordination Structure: OSTP & NSTC

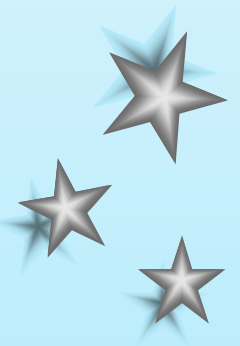
OSTP:

- Created in 1976 to provide the President with timely policy advice and to coordinate the Federal science and technology investment
- Advises the President and others within the Executive Office of the President on the impacts of science and technology on domestic and international affairs
- Works closely with the NCO Director and Interagency Working Group (IWG) on IT R&D to coordinate the interagency Networking Information Technology R&D Program

NSTC:

- Established by the President on November 23, 1993
- Cabinet-level council that is the principal means for coordinating science and technology across the Federal government

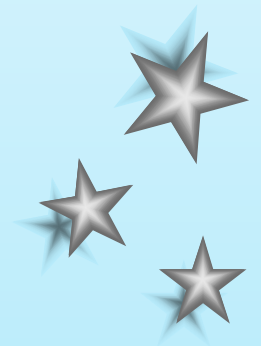
More information can be found at www.ostp.gov





Interagency Working Group (IWG) on IT R&D

- Provides coordination, planning, budgeting, and review of multi-agency IT R&D programs
- Oversees activities of six Program Component Area (PCA) Coordinating Groups and the Federal Information Services and Applications Council (FISAC)
- Provides technical assistance to and coordinates agency response to recommendations of the President's Information Technology Advisory Committee
- Membership consists of representatives from twelve agencies/departments, OSTP, OMB, and the NCO

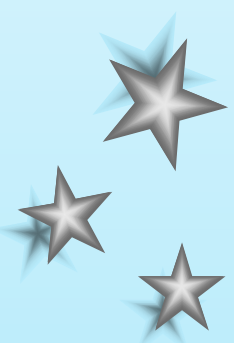




National Coordination Office (NCO) for Information Technology Research and Development (IT R&D)

Mission: *To formulate and promote the Federal Information Technology Research and Development Program to meet national goals.*

- NCO Director reports to the Director of the White House Office of Science Technology Policy (OSTP)
- Coordinates planning, budget, and assessment activities for the Federal multiagency IT R&D programs
- Supports the six technical Coordinating Groups (CGs) that report to the IWG for IT R&D
 - Research planning workshops, conferences, and meetings
 - Presentations, white papers, and research reports
- Provides technical and administrative support to the IWG and PITAC
- Informs the public of Federal achievements and challenges in IT R&D
 - Maintains a Web site
 - Publishes annual budget documents in cooperation with the IT R&D agencies
 - Publishes PITAC reports





IT R&D Program Component Areas (PCAs)

- **Six PCAs**

- High End Computing (HEC)
 - Infrastructure and Applications (HEC I&A)
 - Research and Development (HEC R&D)
- Large Scale Networking (LSN)
- High Confidence Software and Systems (HCSS)
- Human Computer Interaction and Information Management (HCI & IM)
- Software Design and Productivity (SDP)
- Social, Economic and Workforce Implications of IT and IT Workforce Development (SEW)

- **PCA Characteristics**

- PCAs span areas with multiple agencies' involved
- Each PCA includes hardware, software, algorithms, and applications
- Each PCA focuses on specific R&D goals, ensures adequate investments, and maintains necessary budget visibility
- Technology R&D may span PCAs
- Applications span PCAs





IT R&D PCAs (continued)

High End Computing (HEC)

- Advanced computing architectures
- Mass storage
- High end infrastructure to make state-of-the-art computing systems available to researchers

Large Scale Networking (LSN)

- Advanced network communications that are scalable, reliable, and secure
- Software for efficient development and execution of scalable distributed applications

High Confidence Software and Systems (HCSS)

- System reliability — “no-surprise software”
- Information assurance
- Security, privacy, and integrity


Human Computer Interaction and Information Management (HCI & IM)

- Knowledge repositories and information agents
- Collaboratories
- Systems to enable multi-modal human-system interactions
- Virtual reality environments

Software Design and Productivity (SDP)

- Software engineering of complex systems
- Real-time responsive software
- Component-based software design
- Networked and embedded systems

Social, Economic and Workforce Implications of IT and IT Workforce Development (SEW)

- Interdisciplinary research on the interactions and effects of IT in society
 - Curriculum development, fellowships, and scholarships
 - R&D in information-based learning tools, lifelong learning, and distance learning
- 

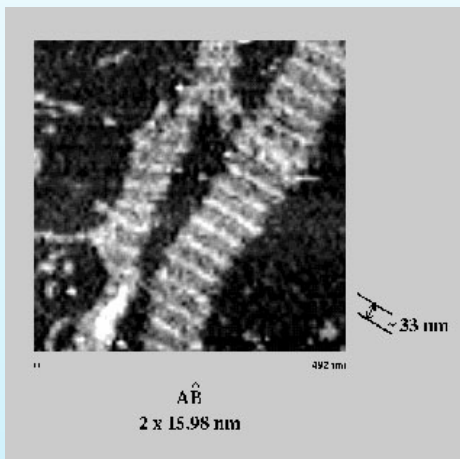
Agency IT R&D Budgets by PCA

FY 2002 Budget Request (dollars in millions)

Agency	HEC I&A	HEC R&D	LSN	HCI& IM	HCSS	SDP	SEW	Totals
NSF	249.7	65.1	98.0	104.8	46.1	39.7	39.1	642.5
DARPA	55.5	42.7	49.2	38.2	32.9	44.6		263.1
NIH	55.1	13.7	81.1	74.6	10.1	6.0	11.4	252.0
NASA	36.1	26.0	14.4	27.8	47.1	22.4	7.0	180.8
DOE Office of Science	98.3	31.5	25.9	16.4			4.0	176.1
NSA		33.6	1.9		46.6			82.1
NIST	3.5		3.2	6.2	7.5	2.0		22.4
NOAA	13.3	1.8	2.7	0.5	1.5			19.8
AHRQ			6.7	9.2				15.9
ODUSD (S&T)		2.0	4.2	2.0	1.0	1.0		10.2
EPA	1.8							1.8
Subtotal	513.3	216.4	287.3	279.7	192.8	115.7	61.5	1,666.7
DOE /NNSA	133.8	37.0	35.5			41.1	56.5	303.9
Totals	647.1	253.4	322.8	279.7	192.8	156.8	118.0	1,970.6

Research Highlights (1)

- **Quantum Computing** — Research to develop a "quantum computer" focuses on sub-atomic particle interactions, which promise to enable unprecedented calculation speeds. NSA has several projects underway, and a consortium of university and Government laboratories is working on a scalable silicon-based nuclear spin quantum computer concept.



- **DNA Data Storage** — One gram of DNA contains 1,021 DNA bases, which is equal to 108 terabytes of information storage. A DARPA- and NSF-funded project is leveraging recombinant DNA techniques — appropriately modified to ensure error resiliency — to solve NP search problems. A key goal of DNA nanotechnology is construction of periodic arrays in 2 and 3 dimensions. The project has produced 2-D arrays from antiparallel double crossover molecules.
- **Sensor information technology (SensIT)** — Microfabricated sensors will be a crucial part of decision-making on the battlefield, disaster response efforts, surveillance with minimal manpower, and maintenance of equipment. DARPA's sensor information technology (SensIT) program is dedicated to maximizing the useful information that a network of thousands of sensors can deliver to key decision-making points in a timely manner. SensIT's mission is to develop all necessary software for a networked system of inexpensive, pervasive platforms that combine multiple microsensors, embedded processors, positioning ability, and wireless communication.

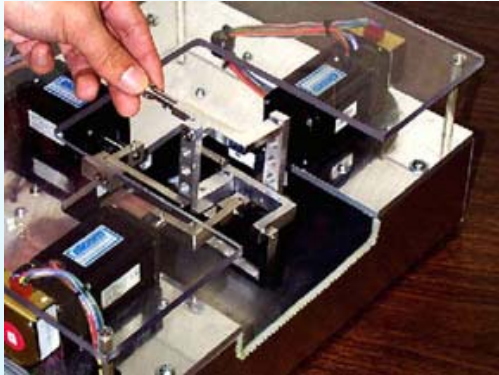


Research Highlights (2)

- **Remote observing** — A new remote observing application will provide authorized scientists located anywhere on high-speed networks with access to the more than \$1 billion in research instruments at the Mauna Kea Observatories in Hawaii. Federal IT research pioneered the advanced networking and software technologies that make distributed applications such as remote observing possible.
- **Internet Protocol security (IPsec)** — NIST's IPsec research develops scalable technologies and tools to make the Internet Protocol — the basic software framework enabling the routing and flow of Internet message traffic — more secure. IPsec enables a centrally controlled access policy and a multilevel security approach to provide security services including data origin authentication, connectionless integrity, replay protection, data confidentiality, limited traffic flow confidentiality, and key negotiation and management.
- **Adaptive learning technologies** — DoD researchers are developing geographically distributed, cost-efficient, versatile, reusable, and adaptable systems to meet education and training goals for DoD's military and civilian workforces — technologies that can be deployed wherever and whenever the need arises. This includes research on human factors leading to the design of effective, efficient, and user-friendly training environments and many other issues.



Research Highlights (3)



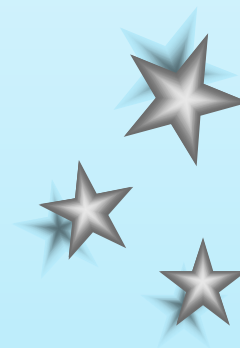
- **Human factors in aerospace systems** — NASA's R&D in human factors will develop advanced human-centered information technology, models of human/system performance, principled methods for human factors design of human-centered computing systems, and human factors expertise to address aerospace challenges. NASA and the University of California-Berkeley have built haptic interfaces for arm-scale and finger-scale manipulation. Its workspace is one-third the scale of the arm device, enough to allow a full range of fingertip motion when engaged in a precision pinch grip with the wrist supported.
- **Education, Outreach and Training** — NSF's Partnerships for Advanced Computational Infrastructure (PACI), comprising the National Computational Science Alliance and NPACI, sponsors joint education, outreach, and training (EOT-PACI) activities to bring PACI-developed high performance hardware capabilities and software learning tools into classrooms at all levels of education and in government. The program also provides training for teachers and other professionals in uses of new technologies. A number of EOT-PACI efforts focus on outreach to women, minorities, and individuals with disabilities, through such means as Web resources, mentoring programs, and IT internships.





The Internet: A Federal IT R&D Success Story

- The Internet was begun with DARPA funding for research to implement researcher-to-researcher exchanges of data (FTP) and text (HTML)
- The Internet has expanded dramatically, particularly in response to the next “killer application”
 - IP
 - Email
 - World Wide Web
 - What’s next? We can’t predict.

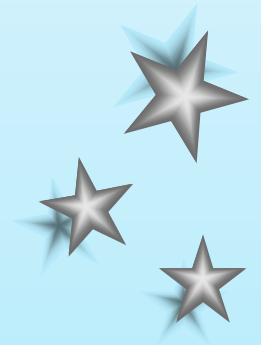




The Current Internet

A key issue is end-to-end performance for end users

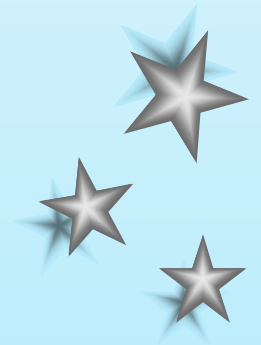
- Bandwidth is increasing dramatically by taking advantage of optical networking
 - Technologies includes wave division multiplexing (WDM) and dense WDM
- Efficiency of bandwidth use is decreasing
 - The number of hops between users is increasing
 - Application/network interfaces aren't well tuned
- Local area networks and local access are often bottlenecks
 - Technology is needed for:
 - Remote access
 - Tether-free access
 - Increased bandwidth for end-user access





The Future of Networking

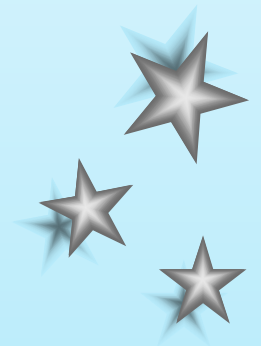
- All optical networking
 - End-to-end optical is needed for end-user performance
 - Optical switches are under development using micro-electro-mechanical systems (MEMS)
- Wireless systems and services
- Practical voice command
- Networks are needed to support:
 - Grids that connect distributed computing systems, storage, and databases
 - Collaboratories with security, quality of service (QoS), and high assurance
 - Sensor nets — billions of networked embedded sensors
 - Unforeseen future applications





Next Generation Internet (NGI) Initiative

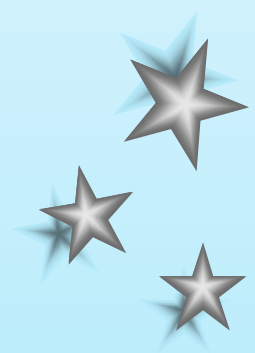
- Presidential initiative
 - Announced in October 1996
 - University based Internet2 announced shortly before
 - Begun in FY 1998
 - Ended in FY 2001, having met its goals
- Approximately \$100 million per year
- Six agencies funded
 - DARPA, NSF, NASA, DOE, NIH/NLM, NIST
- Several other agencies collaborated
- Cooperated with
 - UCAID's Abilene and Internet2
 - AT&T, Cisco, Sprint, WorldCom, ...
- NGI was always part of the Large Scale Networking PCA





NGI Goals

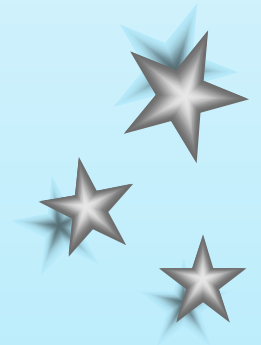
- Conduct R&D in next generation networking technologies to add functionality and improve performance
- Develop NGI testbeds, emphasizing end-to-end performance, to support networking research and demonstrate new networking technologies
 - At least 100 sites at speeds 100 times (100x) faster than the then current Internet
 - At least 10 sites at speeds 1,000 times (1,000x) faster than the then current Internet
- Develop and demonstrate at least 100 revolutionary applications that meet important national goals and missions and that rely on the advances made in the first two NGI goals





NGI Research Accomplishments

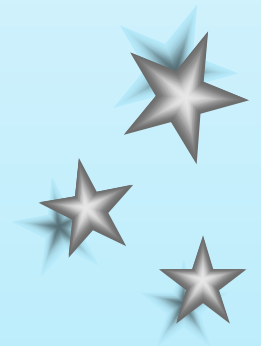
- DARPA
 - Optical networking
 - 1,000x SuperNet testbed
 - SuperNet applications
- NSF
 - 100x testbed
 - Broad spectrum of applications
- DOE — Collaboratory technologies and tools
 - An example is combustion corridors
- NASA — NGIX-West
- NIST — Collaboration with manufacturers on standards
- NIH/NLM
 - Health care applications
 - Health care community awareness of NGI's potential usefulness





NGI Testbed Accomplishments

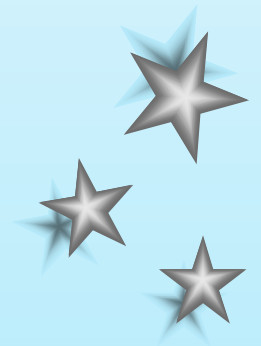
- Established two testbeds
 - The 100x NGI testbed connects more than 150 sites (goal was 100)
 - The 1,000x SuperNet testbed connects 15 sites (goal was 10)
- NGI successfully transitioned high performance networking to the private sector
 - Abilene
 - vBNS+





NGI Applications Accomplishments

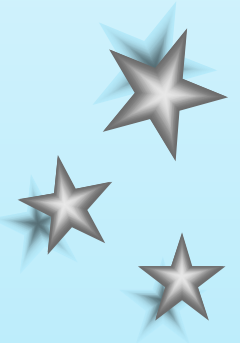
- Developed more than 100 NGI applications
 - Additional hundreds are being developed by universities and industry using NGI testbeds





PITAC Review and Impact of NGI

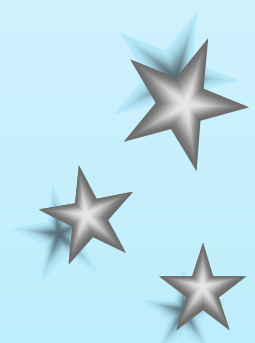
- PITAC reviewed the NGI program in 1999 and 2000
- Findings
 - The NGI Program has made excellent progress
 - “More applications should be funded that demonstrate the utility of the NGI’s Gigabit bandwidth to end-users, its increased security, and its expanded quality of service”
 - Federal agencies should provide more capability to measure network performance
 - Congress should consider additional funding for a program where the NGI research institutions act as aggregators and mentors for nearby smaller or disadvantaged institutions.
- Impact
 - PITAC findings contributed to continued NGI funding
 - Federal agencies significantly increased the funding of NGI applications
 - NGI agencies funded performance measurement of NGI networks
 - NGI agencies funded Educause to assist smaller institutions in taking advantage of high performance networking





After NGI: Large Scale Networking R&D

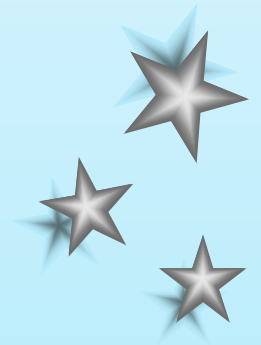
- March 12-14, 2001 Workshop on New Visions for Large-Scale Networks: Research and Applications
 - Workshop report released August 2001
- August 22, 2001: LSN agency planning meeting
- September 24-25, 2001: PITAC Scalable Information Infrastructure review of LSN R&D





LSN New Visions Workshop

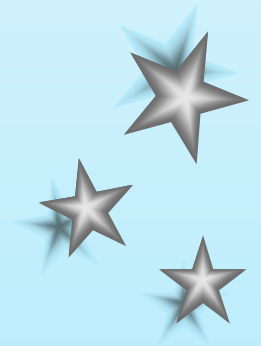
- Objectives
 - Develop a vision for the future of networking (10 to 20 years out)
 - Develop guidance from the private-sector networking research community on networking research
 - Identify needed Federal networking research to help realize the vision
- Participants included more than 160 people from:
 - Universities
 - Industry
 - Research laboratories
 - Federal agency networking research organizations





LSN New Visions Workshop Scenarios (1)

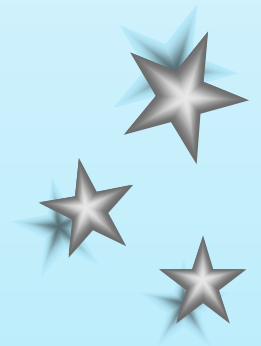
- Zero-casualty war
 - The intelligent, automated, densely sensed battlefield
- Smart world
 - Intelligent aware, secure, embedded sensors for maintaining battlefield systems
- Crisis management
 - On-line emergency resources supported by distributed sensors, dynamic networking, and distributed high-performance modeling





LSN New Visions Workshop Scenarios (2)

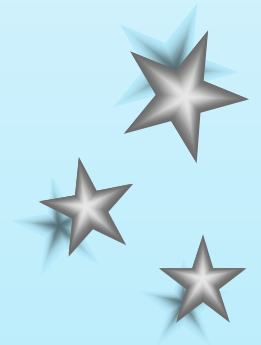
- Collaboratories
 - Proactive, intelligent, dynamic, “natural” interactions
- Networked medical care
 - Distributed medical services through collaboration with high security, high assurance, and guaranteed QoS
- High energy physics
 - Collaboration with high-end, on-line resources





LSN Workshop: Research Needs

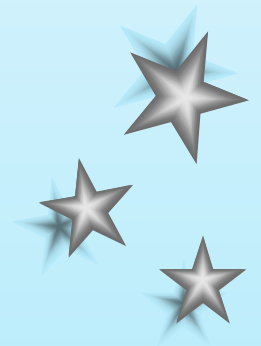
- Adaptive, dynamic, and smart networking
- Measurement, modeling, simulation, and scalability
- Trust: security, privacy, and reliability
- Networking applications
- Networking middleware
- Testbeds
- Collaboration environments
- Revolutionary research
- Revisit networking fundamentals





Areas for Interagency LSN Cooperation

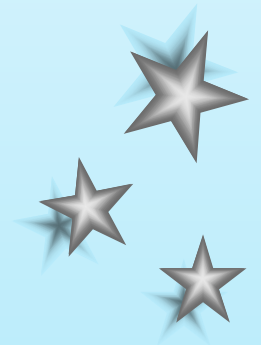
- End-to-end systems
- Grids and collaboratories
- Mobile networks and hybrid systems
- Network measurements, modeling, simulation, and monitoring
- Networking security
- Testbeds
- Transport protocols and control theories





Current LSN Programs (1)

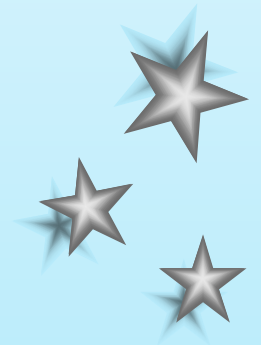
- NSF
 - ITR awards: scalability, availability, reliability, end-to-end performance, adaptability
 - Distributed Terascale Facility with 40 Gbps network links
 - Network centric middleware services program
 - High performance network connections for science and engineering research
- DARPA
 - Networking in the Extreme (NetEx): Ultrawideband wireless technology
- DOE
 - Network middleware
 - Large scale national and international scientific collaborations
 - Scientific Discovery for Advanced Computing (SciDAC)





Current LSN Programs (2)

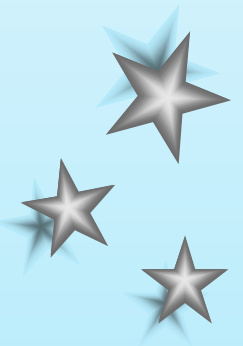
- NSA
 - Network security
 - Interagency effort for ATDnet replacement
 - Transport protocols and control theory
- NIST
 - Wireless ad-hoc networks
 - Agile switching
 - Quantum information networks
- NASA
 - Integration of services
- NIH/NLM
 - Health care application implementation
- NOAA
 - Collaboration
 - Disaster Response





Examples of Industry Involvement

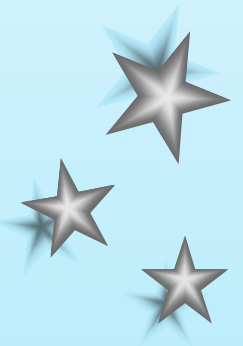
- Federal agencies contract with the commercial sector for research and development
 - Web 100: Intel, Sun and others are developing an automatically tuned application/network interface.
 - All optical networking: Ciena and others are developing key optical networking components.
- Federal agencies purchase network services from commercial providers, giving the providers direct experience with high-performance networking. Providers contribute significant services and equipment (value is many times the Federal contribution)
 - vBNS+ network (NSF) is provided by WorldCom
 - DREN is provided by AT&T
 - ESnet is provided by Qwest
 - NREN is provided by Qwest





Industry Involvement (Continued)

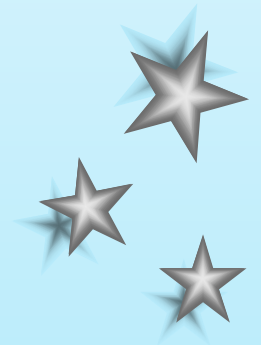
- Commercial sector participates directly in Federally funded testbeds, e.g. Quality of Service Backbone network (Qbone) participants include NASA, NSF, DoD, Internet2, Cisco, Spirent, Torrent/Ericsson, and Nortel. The commercial sector provides services and equipment for testing.
- The commercial sector participates in the Joint Engineering Team (JET) that architects the advanced R&D networks: Cisco, Qwest, and WorldCom.





Types of Industry Involvement

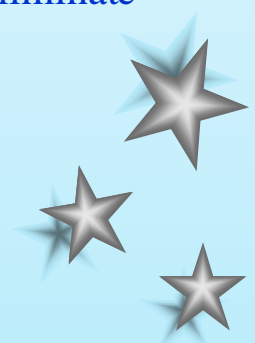
- CRADAs
- Collaboration
- IPAs
- Consortia
- Start-ups
- Tech Transfer
- Procurement
- Standards Development
- Advisory Committees





Compelling Reasons for Continued Federal IT R&D Funding (& Multi-agency Coordination) (1)

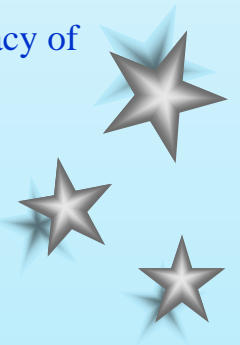
- Federal agencies need advanced information technologies to meet their mission goals
 - Advanced IT is needed not only in its own right but also in both R&D and applications in all scientific and engineering endeavors
 - This includes biology, chemistry, mathematics, physics, and engineering ranging from designing aircraft design to developing advanced medical diagnostic and treatment devices
- IT R&D is needed to developed these technologies
- There is substantial overlap in agency needs
 - Coordination enables the Federal R&D agencies to leverage their investments, eliminate duplication, and identify and address research gaps
- Different agencies have different funding mechanisms
 - Advantages include flexibility and the ability to have several agencies fund projects, each with different goals





Compelling Reasons for Continued Federal IT R&D Funding (2)

- There is substantial overlap between Federal needs and private sector needs
 - Examples include high end computing, high speed networking, large database technologies
 - Federal needs can be larger than private sector needs (at least initially)
 - Some Federal needs will always be different from private sector needs (national defense and national security are examples)
- Results from Federally-funded IT R&D have benefited the private sector
 - Past Government-funded IT R&D has yielded huge economic returns on investment, and continues its pivotal role in promoting innovation
 - Funding research helps the intellectual base grow, thereby ensuring continued innovation
 - Federal IT R&D investments that address agency mission needs often anticipate private sector needs
 - An example is technologies to help guarantee availability, reliability, security, and privacy of information systems, which are current IT R&D areas





Compelling Reasons for Continued Federal IT R&D Funding (3)

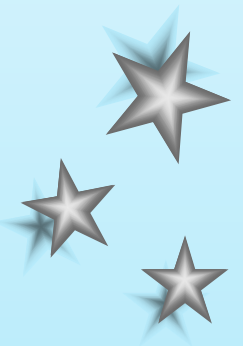
- Federal IT R&D investments and private sector IT R&D investments are complementary
 - The Government invests in general-purpose, broadly useful, and interoperable technologies, tools, and applications
 - The Government can invest in technologies that may take decades to mature
 - The inability to appropriate a ROI in generic technologies by an individual company prevents such an investment
 - A company invests in technologies that give it competitive advantage and looks to the next quarter for its return on investment
- Much of what the Federal government funds is performed or provided by the private sector
 - University based research
 - University research infrastructure (including computing systems and advanced networks)
 - R&D performed by industry for agencies including DoD, DOE, and NASA





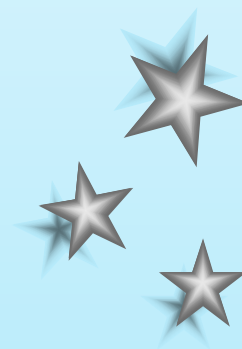
Compelling Reasons for Continued Federal IT R&D Funding (4)

- Transfer to the private sector of both information technologies and people who can create and use these technologies is a natural by-product of Federally-funded IT R&D
- Today the U.S. relies heavily on its IT leadership to maintain national security, national defense, and economic competitiveness, and continued Federally-funded IT R&D helps assure that leadership in the future





Discussion of Program Prospects: The Future of the NCO and the IWG for IT R&D





For Further Information on Federally Funded IT R&D

Please contact us at:

National Coordination Office for
Information Technology Research and Development
4201 Wilson Boulevard, Suite II- 405
Arlington, VA 22230
(703) 292-4873 (ITRD)
nco@itrd.gov

Or visit us on the Web:

www.itrd.gov

